THE COMPARISON OF TEMPERATURE WITH MAGNETIC HORIZONTAL FORCE.

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In response to the request of the Chief of the Weather Bureau, the directors of the observatories at Toronto, Washington, and San Antonio have courteously undertaken to forward to the Bureau, as promptly as possible, certain data from their magnetograms, namely, the mean ordinates for the day from twenty-four hourly readings of the horizontal force, the declination, and the vertical force, uncorrected for instrumental errors and changes of temperature. On days exhibiting very disturbed magnetic conditions the hours and the values of the maximum and minimum ordinates are given.

The object in collecting these data is to institute a comparison between the crude magnetic readings, particularly of the bifilar, and the temperature changes at meteorological stations in the Northwest. Ultimately such comparisons will show how far unreduced magnetic observations may be available for determining the direction and the intensity of the temperature variations and other weather conditions before these become fully developed, as given by the isotherms and isobars of the daily weather maps. It has already been shown that weather and magnetism conform on the average to a normal type, but the problem of the synchronous changes from day to day is still under advisement as a practical feature in forecasting. The original data are presented on Chart V in a slightly reduced form, without further comment, thus offering the reader an opportunity for individual study.

The columns headed Calgary, Williston, and Sioux City give for each day, respectively, the mean of the 8 a. m. and 8 p. m. observations of temperature at the following groups of stations:

Calgary for Minnedosa, Qu'Appelle, Prince Albert, Swift Current, Medicine Hat, Battleford, Edmonton, Calgary.

Williston for Valentine, Yankton, Huron, Pierre, Moorhead, Bismarck, Williston.

Sioux City for Springfield, Mo., Kansas City, Wichita, Concordia, Omaha, Sioux City.

The average temperature for each group is reduced back to the origin, W. 115°, N. 55°, by a correction for eastward drift (see Amer. Jour. Sci., Dec., 1894). The first differences of these numbers are taken; then the monthly mean of the first differences for slope; then the variations on the slope; then these latter are added successively throughout the month and the accumulated sums give the ordinates of the curve for each group; the mean of these three groups is taken and gives the curve in the upper part of Chart V; the monthly mean of the ordinates is added with reverse sign to reduce to a true datum line. Thus, the eastward drift and the slope have been eliminated, and the variations reduced to a zero base line.

The magnetic data are treated in the same way as the temperatures. The curve as plotted is the mean of the ordinates of the three stations. It has been found that at least five magnetic observations are required to eliminate local conditions and to give a true value of the external impressed field, though seven are better. By inspecting the columns it will be seen that local variations disturb the curves in certain cases. Hence, as the data now exists, the comparison can give only partially accurate curves as to detail, though the main features may be expected to appear.

SPECIAL FEATURES OF THE DECEMBER CURVES.

The temperature and magnetic force variations need no correction for slope; San Antonio is reduced for amplitude by the factor $\frac{1}{5}$; the mean temperatures are reduced to a zero datum line by $+1$, and the mean magnetic force by -2.

The 26.68 day period began on December 20.26.

Light magnetic disturbances were reported from San Antonio on December 13, 14, 15, and 16.

INLAND NAVIGATION.

STAGE OF WATER IN RIVERS.

The following table shows the danger point and the highest and lowest stages for the month of December, 1894:

Heights of rivers above low-water mark, December, 1894.

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Height.	Date.	Height.	Date.	
Red River.	*Feet.*	*Feet.*		*Feet.*		*Feet.*
Shreveport, La	29.2	— 4.2	27	— 5.5	2-4	1.3
Arkansas River.						
Fort Smith, Ark	22.0	1.4	5, 6, 10, 11	0.1	1	1.3
Little Rock, Ark	23.0	4.7	12	2.3	1	2.4
Missouri River.						
Pierre, S. Dak.*	13.0					
Sioux City, Iowa*	18.7					
Kansas City, Mo.†	21.0	6.9	27	4.3	21	2.6
Mississippi River.						
St. Paul, Minn	14.0					
La Crosse, Wis.‡	10.0	2.1	7-9, 12, 13	1.0	1	2.0
Dubuque, Iowa†	16.0	2.2	13-16	0.3	4-28	1.9
Davenport, Iowa†	15.0	1.8	28	— 0.2	6	2.0
Keokuk, Iowa†	14.0	1.2	20	— 0.5	4	1.7
Hannibal, Mo	17.0	1.4	21, 22	— 0.8	31	2.2
St. Louis, Mo	30.0	3.7	5	1.5	30	2.2
Cairo, Ill	40.0	12.6	21	4.6	1	8.0
Memphis, Tenn	33.0	5.9	25	— 0.1	1, 2, 4	6.0
Vicksburg, Miss	41.0	5.1	30	— 4.0	1	9.1
New Orleans, La	13.0	3.7	28	2.5	10	1.2
Ohio River.						
Parkersburg, W. Va	38.0	12.0	15, 16	5.0	1	7.0
Cincinnati, Ohio	45.0	19.4	18	6.8	4, 5	12.6
Louisville, Ky	24.0	10.0	20	3.8	6, 7	6.2
Cumberland River.						
Nashville, Tenn	40.0	13.6	17	1.2	4, 6, 7	12.4
Tennessee River.						
Chattanooga, Tenn	33.0	11.2	14, 15	0.9	2-8	10.3
Knoxville, Tenn	29.0	7.9	14	0.0	1, 2	7.9
Monongahela River.						
Pittsburg, Pa	22.0	9.2	14	2.8	30	6.4
Savannah River.						
Augusta, Ga	32.6	25.0	14	5.3	3	19.7

Heights of rivers—Continued.

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Height.	Date.	Height.	Date.	
Willamette River.	*Feet.*	*Feet.*		*Feet.*		*Feet.*
Portland, Oregon	15.0	6.8	12	2.6	28, 29	4.2
Alabama River.						
Montgomery, Ala	48.0	15.4	15	— 0.1	7-9	15.5
James River.						
Lynchburg, Va	18.0	2.6	14	0.0	4, 9, 29	2.6
Sacramento River.						
Red Bluff, Cal	22.0	21.5	21	1.0	2	20.5
Sacramento, Cal	25.0	20.0	31	9.2	1, 5	10.8

* River frozen. † Record for 28 days. ‡ Record for 27 days.

ICE IN RIVERS AND HARBORS.

Albany, N. Y., 24th, navigation on the Hudson River closed to-day.

Buffalo, N. Y., navigation closed 25th.

Cairo, Ill., ice floating in river 28th; on the 29th navigation temporarily closed on Mississippi River, and running ice in that river and the Ohio River; 30th, navigation impeded on Ohio River.

Chicago, Ill., 10th, navigation closed.

Cleveland, Ohio, floating ice 28th to 31st, and navigation closed 31st.

Des Moines, Iowa, 23d, river frozen.

Detroit, Mich., navigation closed 20th.

Duluth, Minn., navigation closed 7th.

Grand Haven, Mich., 31st, ice in river.

Green Bay, Wis., 10th, navigation closed.

Harrisburg, Pa., 28th, river frozen.

Keokuk, Iowa, Mississippi river frozen 29th.

La Crosse, Wis., 25th, floating ice in river; 27th, river gorged on east side, but west channel clear.

Marquette, Mich., 4th, navigation closed.

New Brunswick, N. J., navigation on Raritan River closed by ice 29th.

Louisville, Ky., 31st, floating ice in river.